Forces and Motion

8-5 The student will demonstrate an understanding of the effects of forces on the motion of an object. (Physical Science)

8-5.4 Predict how varying the amount of force or mass will affect the motion of an object.
Taxonomy level: 2.5-B Understand Conceptual Knowledge

Previous/Future knowledge: Students have been introduced to the concept of the importance of pushing and pulling to cause a change in motion in the 1st grade (1-5.2). In the 3rd grade students have studied how the motion of an object is affected by the strength of the push or pull on an object (3-5.3) and the relationship between the motion of an object and the pull of gravity (3-5.4). Students have been introduced to the concept of forces and how they affect motion in 5th grade (5-5.1) as well as to the concept of how mass can affect motion (5-5.6) Students will further develop the concept of the how force and mass affect motion quantitatively in high school Physical Science (PS-5.8).

It is essential for students to know that varying the amount of force or mass will affect the motion of an object.

Force

- If an object is in motion and more force is applied to it, the object will begin moving faster.
- If two objects have the same mass and a greater force is applied to one of the objects, the object which receives the greater force will change speeds more quickly. For example if a ball is hit harder, it will speed up faster.
- If an object must be slowed down quickly, the force applied to the object must be greater than what is needed for a gradual slowing down. For example, the greater the force applied to the brakes of a bicycle, the more quickly it will slow down or stop.
- Varying the amount of force applied to a moving object can also change the direction that the object is moving more or less quickly. For example, a baseball pitched toward the batter may quickly change direction and speed if hit very hard, or may change direction and speed more slowly if hit softly as with a bunt.

Mass

- If a heavy (more massive) object is in motion, more force must be applied to get the object moving faster.
- If the same force is applied to two objects, the object with the smaller mass will change speeds more quickly. For example if a baseball and a bowling ball are thrown with the same force the baseball will speed up faster.
- In order to slow down or stop a heavier (more massive) object, the force on that object must be greater than for a less massive object. For example, if the same braking force is applied to a small car and a large truck, the car will slow down more quickly.
- It is more difficult to change the direction of a heavy moving object, than one that is lighter in mass.

It is not essential for students to know the specific quantitative relationships among force, mass, and movement of objects (F = ma) or Newton's Laws of Motion.

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Assessment Guidelines:

The objective of this indicator is to *predict* how varying the amount of force or mass will affect the motion of an object; therefore, the primary focus of assessment should be to infer from the presented material how the amount of force or mass will affect the motion of an object in terms of change in speed and/or direction. However, appropriate assessments should also require students to *exemplify* ways that varying the amount of force exerted on an object affect the motion of the object; or *exemplify* how changes in mass affect the motion of objects; or *explain* how varying the amount of force or mass will affect the motion of an object.-